XML based Data Handling for Ultra Precision Machining of Free Form Surfaces

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Abstract

Today's optic industry shows a sure trend towards more precise optical surfaces, leaving regular geometries and introducing more and more complicated free forms [1]. Within the process chains for generating free form surfaces one of the greatest challenges is data handling. At Carl Zeiss the deterministic and economic production of high quality optical surfaces with complex geometries is pursued. To this end software solutions are strived for which are able to cope with current data-handling challenges for ultra precision manufacturing.

In order to overcome problems that occur due to data transformations Zeiss pursues the implementation of a XML based data exchange. The advantage of the XML data handling is the complexity of different information that can be stored in just one file. What kind of information is to be stored in which place is determined by the feature-server. A database system handles the in and output relations of the different process steps and allots all reading and writing permissions.

1 Process Chain

In the manufacturing of free form surface products a lot of departments are involved, that have different kind of responsibilities within the process chain and use different kind of software to fulfil their duties. At Zeiss usually the departments for optic design, construction, component manufacturing and assembly and alignment are involved. Within this process chain for generating free form surfaces one of the greatest challenges is data handling. The main issues are:

- the required accuracy of original data has to be in the nm-range,
- handling of large data-clouds is still unfit for mass-production (transition from 32 bit to 64 bit software is needed)

- conventional software and data-interfaces are not designed for ultra precision processes (e.g. free programmable accuracy)
- often process chains are managed with detail solutions, which are not transferable and need a vast assortment of diverse software (design, CAD, CAD/CAM, machining, measurement, etc.)
- accuracy of 3D-CAD-models is insufficient, no surface manipulation, or extension possible
- almost no UP DIN-compatible posts, nor controller are available
- nearly no realized UP data feedback, no UP re-engineering with nm-tolerance possible

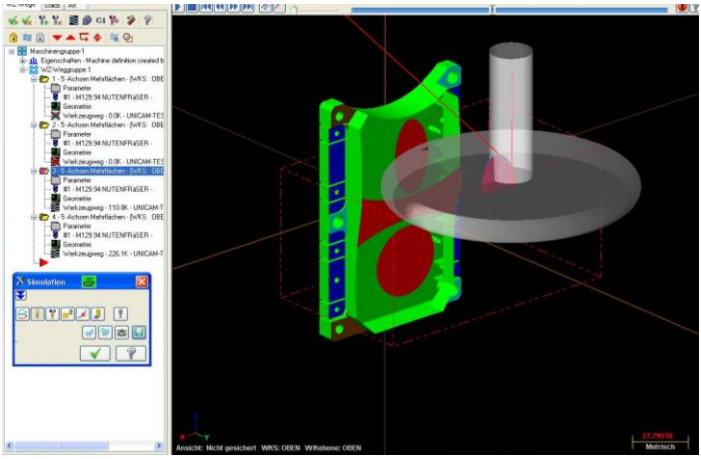

Figure 1: 64 bit, multi core CAM Software

At Carl Zeiss the deterministic and economic production of high quality optical surfaces with complex geometries is pursued. To this end software solutions are strived for which vanquish aforementioned data-handling challenges for ultra precision manufacturing.

The description of free form surfaces is a complex issue. Besides all above mentioned important points it is not sufficient to describe a free form only with a drawing and a 3D-CAD model only given by IGES or STEP-files e.g. Because of its complexity more information is needed in the various interfaces between the single steps of the

process chain. Big issues are for example references, or coordinate transformations (model, machine, measurement device), etc.

2 XML Data Format

Within the BMBF-founded project "FREE" the challenge of high data volumes for free form surfaces described accurately in the 1nm - range is dealt with [2]. Meanwhile software solutions with 64bit, multi core technology for CAD / CAM which are able to handle several million data points creating several GB NC-files in the 1nm accuracy range were developed. These software solutions work in a laboratory setup (see fig. 1).

This paper focuses on the data exchange. One possibility to overcome the limitations due to data exchange is the implementation of a XML based data structure. The advantage of the XML data handling is the complexity of different information that can be stored in one file. What kind of information is to be stored in which place is determined by the feature-server. The feature-server gives a data framework which can be filled with data and information by different kind of software. This data can be coefficients, point-clouds, NURBS, vectors, material information, references, etc. The chosen feature server works according to the DIN standard, which is based on ISO 13584-42 and IEC 61360-2. In this way a worldwide standard for creating, assigning permissions and compatibility of the data format is granted in the future. Following requirements have to be met [3]:

- Features have to be standardized
- The data in the features have to be processable
- Features need a global unique identification (GUID)
- All software need I/O interfaces
- Access to a feature library with sufficient content all over the process chain
- Simple upgrading for company specific needs

At Carl Zeiss a feature-server has been established according to the standard of the DIN feature-server. A couple of processes for aspherical optics have been included for proof of principle (administration, parts in a system, material, coatings, etc.). Within the next two years the whole process chain for ultra precision free form manufacturing is supposed to be handled by one software platform, which solely

communicates over XML-data files. The storage of these files will be handled by a database-system which allots each process-step its reading and writing permissions.

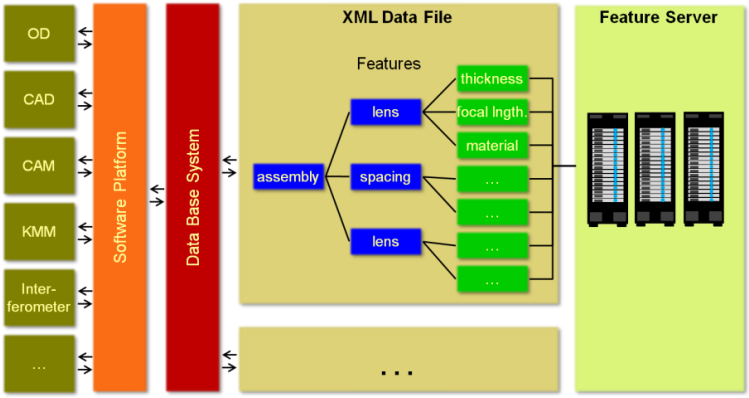

Figure 2: Software and File-Structure of XML based System

3 Software Platform

The next step will be to create a software platform for the whole process chain. For highest precision native data formats for the different kind of data (surface, point cloud, etc.) are needed, which are not be altered by transformation or format translation. These data will be stored in a XML data structure along with other crucial information like references, edges, surface extensions, etc. All software connected to the software platform will need an interface to handle the native data. The software platform will reduce the amount of needed interfaces and data conversions. In this way faults due to data handling will be eliminated. An overview of the whole data handling structure is illustrated in figure 2.

References:

[1] “Lighting the way ahead”; Second Strategic Research Agenda in Photonics; Photonic 2020; Deutschland, 2010, www.Photonics21.org

[2] BMBF-Ausschreibung Themenfeld „Freiformoptiken“ im Rahmen des Förderprogramms "Optische Technologien", März – Juni 2009; BMBF Referat 515 "Forschung an Fachhochschulen, Ingenieurnachwuchs, FIZ"

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